

***RESOLVING THE SINGLE-
VERSUS MULTIPLE-SET
STRENGTH TRAINING
DEBATE***

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For decades, debate has persisted regarding the amount of work (volume or number of sets) a person must perform in the weight room to elicit maximal strength gains. A very small, but vocal group has promoted their opinion that single-set training programs will elicit maximal, or near maximal, strength gains and additional sets of training are of no value. The vast majority of exercise professionals and leaders in our field, however, have founded their prescription of training volume on two fundamental exercise principles: the dose-response and progression. These principles, the experience of our most knowledgeable professionals, and the body of research examining this issue overwhelmingly support the need for multiple-set training programs to achieve maximal strength gains.

The dose-response is a training principle that states that a given stress or dose will result in a certain response with higher doses eliciting a greater response up to a certain point. After this point of maximal effectiveness, benefits of increased dosages begin to diminish and an overdose is observed. In the pharmaceutical world, the principle of the dose-response is a very familiar and important concept. Physicians must know the degree of impact that a specific dose of a drug will have in order to prescribe the correct amount. Too little dose will fail to achieve the needed change in health or condition while an overdose may carry severe adverse effects. Similar to pharmaceutical drug prescriptions, exercise professionals prescribe resistance training programs (of varying doses) to elicit the needed or desired degree of strength development. Prescribing too little work will result in a failure to achieve the desired or needed strength gains while too much work could result in overtraining. The principle of progression states that once an individual has become accustomed to a stimulus, they must add additional stress in order to stimulate continued responses. In other words, the dose must be progressively increased to result in continued adaptation. These principles have been developed through years of research and practice and have continually been supported by such work.

Hundreds of studies have examined the amount of strength improvement elicited by training programs involving different training doses (i.e. sets, intensity, etc.). Unfortunately, taken separately, each study provides only a small glimpse of the dose-response relationship. Luckily, methods have been developed over the past 20 years for combining individual studies in a way that leads to reliable information (5, 6, 7). Such procedures, called meta-analysis, involve a process of systematically combining separate but related studies so that the findings can be compared. The meta-analysis allows researchers to come to a consensus regarding disputed outcomes among individual studies by increasing statistical power and summing the results of the body of research as a whole.



This is especially important among bodies of research, such as strength training, where statistical power in each study may be low due to small sample sizes.

Recently, several meta-analyses have been completed on a large body (nearly 200 studies) of strength training literature (2, 3, 4, 8) in search of the dose-response for strength development. Taken individually, many of these studies have found no statistical difference between single- and multiple-set training programs due to low statistical power. Most of these studies included little more than a handful of participants making it almost impossible for conventional statistics to identify a difference between the training programs when, in fact, a difference did exist. With the results of hundreds of studies combined through meta-analytical techniques, it becomes quite obvious that single-set training programs do not elicit maximal, or even near maximal, strength gains. Even in groups of people just beginning a training program, those requiring the least amount of training to see improvements, up to four sets per muscle group is needed to see maximal strength gains. In this population, one set results in less than half of the strength elicited by multiple sets. For trained populations, progression to five or six sets is required to see maximal gains, while athletes (very highly trained populations) must perform about eight sets per muscle group to experience maximal strength gains. In athletes, the meta-analyses demonstrated that single-set training programs elicited minimal, if any, strength gains.

This research has made it apparent that different doses of training volume will result in a different magnitude of strength development and the amount of strength improvement with different doses changes as an individual becomes more highly trained. Once again, strong evidence supports the principle of the dose-response. Since publication of these analyses, additional studies have been added to the database and the dose-response for strength development has been further solidified (Figure 1).

Having dispelled the myth that single-set programs will elicit maximal gains, the question of who might benefit from performing just one set arises. To answer such a question, one must ask how much strength gain is needed and how much time an individual has to exercise. If only small amounts of strength gain are desired, single-set programs can be sufficient for lesser training populations because even low amounts of stress are sufficient to stimulate some improvements. However, if large gains are desired or needed, much more work must be performed. If time is limited, then performing as much work as time permits is better than doing nothing. However, it must be acknowledged that such a situation will not result in maximal strength gains and any argument to the contrary is misleading and unsubstantiated. The meta-analyses have

supported what most serious strength trainers already knew: it takes significant time and effort to develop high levels of strength.

Applying this knowledge to real-life situations can assist in the development of training programs for a variety of populations. First, beginners should be cautious about attempting to do too much work too soon. They should begin slowly, perhaps following a single-set, low-intensity training program. As they become accustomed to training, usually in a matter of a few months, additional sets can and must be added if increased strength gains are desired. Such “progression” should occur gradually with no more than one set added each week but must occur for additional strength gains to be achieved.

Progression is a principle that every avid strength trainer can attest to. Even more importantly, a group of the most experienced and knowledgeable leaders in our field recently compiled one of the most thorough and respected statements in support of the principle of progression for the American College of Sports Medicine (1). Training experience and vast amounts of research have demonstrated that low volume (single-set) programs become less and less effective as people become more highly trained. Such programs do not present sufficient stimulus to cause a highly developed neuromuscular system to improve itself. An individual must progress to a greater stimulus in order to elicit continued adaptations.

By adhering to physiological principles such as the dose-response and progression, exercise professionals can develop safe, effective strength training programs. The vast body of research examining different doses of training has provided us with ample evidence and detail regarding how much work should be done to achieve a given increase in strength. The past confusion among some in our field and the resolution of the debate over single versus multiple set training programs should teach us that exercise principles that have been established, tested, and validated should be the foundation of prescription for strength development.



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Figure 1: Magnitude of Strength Improvements by Volume

